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Twenty infants, 12 weeks of age, were subjects in an experiment to test the effects of maternal behavior on their perceptual-cognitive development. Each mother and child were observed in a controlled naturalistic setting, every 10 seconds their various behaviors were recorded, and then the mother was interviewed. During an experimental session the infant was placed in a reclining seat with a matrix panel on which stimuli were presented 18 inches in front of him. The mother sat to the rear and side of the infant. Response decrement was positively correlated with the amount of touching, looking, holding, and smiling the mother exhibited and negatively correlated with the amount of time the mother was reading. Higher frequencies of maternal response were associated with greater response decrement. Data consistently indicate there is positive correlation between maternal response to infant behavior and the cognitive development of the infant as measured by response decrement. Helplessness or control is a learned motive and has important consequences for subsequent perceptual-cognitive development. Maternal behavior stimulates within the infant the expectancy that his behavior can affect his environment and motivates him to produce and utilize behaviors and skills not reinforced in his past experience. (DO)

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Perceptual-Cognitive Development in Infancy: A Generalized Expectancy Model as a Function of the Mother-Infant Interaction[1]

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The role of the mother in infancy has long been considered important in the emotional development of the child. In recent years, with increased interest in cognitive development during infancy, there has been a corresponding increase in concern for the way in which the mother or caretaker might influence the infant's intellectual development.

The traditional view attributed intellectual ability largely to genetic factors. An individual had an innate capacity for intellectual development which was fixed and unfolded in a predetermined sequence as the infant matured. Since World War II, investigations of the effects of infantile experience have amassed sufficient evidence to demonstrate that at least some aspects of intellectual ability are learned, that is, influenced by experience (see Hunt, 1961, 1963). Thus, the mother or caretaker who is a primary source for a large part of early experience is potentially important for intellectual development. Although psychoanalytic

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theory was one of the major contributions to the notion of the importance of early experience, it generally assumed these influences to be primarily emotional (Freud, 1905). The mother's love was seen to be essential to healthy emotional development. Extreme deprivation in early life might result in emotional problems which interfered with or prevented normal intellectual development. By and large, the capacity for intellectual development was, according to the psychoanalytic view, still fixed. Unsatisfactory emotional experiences could prevent free intellectual development, while adequate mothering provided the security in which innate capacity could reach its full potential.

It is now clear that some of the studies thought to demonstrate that maternal absence resulted in emotional starvation (e.g., Spitz, 1945; Dennis & Dennis, 1941) may be interpreted in another way. The mother is also a primary source of stimulation for the infant. What the infant lacks in her absence is not only emotional satisfaction, but stimulation as well. The developmental deterioration observed by Spitz and Dennis may well be attributed to this lack of stimulation rather than emotional impairment. Indeed, in a later paper, Dennis (1960) suggested that the source of severe retardation he observed in a Teheran orphanage was "homogeneity of stimulation."

More recently, the importance of the mother as a source of stimulation, as well as of emotional satisfaction, has been

emphasized in a number of different approaches. Hunt (1963) for example, suggests that in the early months, the child is responsive primarily to changes in stimulation. Therefore, the extent to which the mother provides for frequent encounters with a wide variety of situations involving change in stimulation influences the infant's early learning. This applies both to the behavior of the mother and the total environment she provides. Thus, frequency and variation of stimulation are seen as the characteristics important in early development and the extent to which the mother provides this can depress or enhance the child's subsequent development.

Another view that is represented by Gewirtz (1966) and Watson (1966, 1967) is based on the role of the mother as a source of reinforcement. The infant will tend to repeat those behaviors which are reinforced within his memory span. Since the infant's memory span is judged to be relatively short (at three months, it is estimated to be about five seconds [Lewis, 1967; Watson, 1967]), reinforcements must follow behavior fairly quickly if he is to be aware of the contingencies involved. According to this view, the mother can encourage learning of desirable behaviors by contingent reinforcement of these behaviors when they occur.

A third approach also centers on the notion of contingency but maintains that contingency is important, not only because it

shapes acquisition of specific behaviors, but because it enables the child to develop a motive which is the basis for all future learning. The main characteristic of this motive is the infant's belief that his actions affect his environment. In this case, the mother is important because it is the contingency between the infant's behavior and her responses that enables the infant to learn that his behavior does have consequences. The main differentiation between this view and the operant conditioning position is that the latter predicts only change in specifically reinforced behaviors while the former predicts change in behaviors not specifically reinforced.[2]

It is this last approach with which the present paper is concerned. Data from the Fels Infant Study which support this view will be examined first, and subsequently, this view will be discussed in relation to research with older children as well as animal work which is consistent with this approach.

In order to observe the mother-child interaction and its effect in cognitive development, it is necessary to have some measure or continuum along which infants vary and which show changes indicative of cognitive development.

Recently, a model of schema development believed to represent a measure of cognitive capacity has been presented (Lewis, 1967; Lewis, Goldberg & Rausch, 1967). This schema development rests on

the assumption that response decrement to a redundant signal does not necessarily depend on sensory fatigue or nerve accomodation.

It is believed that response decrement to a redundant signal is related to some more central process rather than a peripheral process such as organism or receptor fatigue. A neuronal model for explaining just such a response decrement has been offered by Sokolov (1963) who suggests that central processes such as neuronal model acquisition (memory or storage of information), are involved in response decrement to repeated stimulation. He defines a neuronal model as an organization of neural cells in the cortex which retain and process such information as intensity, duration and quality of stimuli. Such a model is developed by the repetition of the same stimulus. In the process of model building, if the presented stimulus corresponds to the model, some type of negative feedback occurs, resulting in the decrease or absence of a response. However, if the presented stimulus does not correspond with the neuronal model or the model is not yet fully developed, central excitation takes place and an orienting reflex occurs. One might view model acquisition in the following way. Each presentation is compared to any memory trace or model created by the preceding presentations. Memory trace is reinforced or the model is made stronger by some process such as increasing the number of neuronal cells involved or by more permanent

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biochemical changes. Moreover, this postulated model and process of testing may involve many cells and their interaction or even possibly single cell memory.

In addition to Sokolov's work, there is a growing body of neurophysiological data demonstrating that central changes such as negative slow potential change in the human cortex take place as a function of the organism's building up of expectations (that is, the memory or model of some event) through repetitive stimulus presentation (Walter, 1964; Rebert, McAdam, Knott & Irwin, 1967; Walter, Cooper, Aldridge, McCullum & Winter, 1964). Moreover, visually evoked potentials are not solely determined by the physical qualities of the signal, but by such factors as reducing uncertainty, or the confirmation of an expectation (Sutton, Tueting, Zubin & John, 1967). These recent studies supply direct evidence for cortical changes as a function of the build-up of expectations or models.

This proposed model does not try to arrive at a final explanation of the mechanisms governing response decrement. It does, however, assume, as Sokolov does, that this process is related to some central mechanism such as memory or neuronal model acquisition. According to the theory, one way to measure the strength of the model is to observe whether the signal produces attentive behavior. As models (memory or schema) are built up, signals which match that

model elicit little attention and lead to response decrement (we have called these stimuli familiar). Signals which do not match the model elicit attention and produce response recovery (we have called these stimuli novel). Finally, it appears that signals for which there is no model at all produce little attention. Thus, amount of response decrement is an important measure of model acquisition.

In the investigation of models, one can look at either experimentally produced models or models which the experimenter knows to have been developed or which are developing in the infant. Such models could include face schema (Lewis, 1965; Kagan, et al., 1966) or conservation of substance (Piaget, 1954). Experimentally, models are produced by repeated presentation of a single signal. In the experimental production of models, the experimenter assumes the model is short-lived. The models which are built up over long periods of time are found in the environmental events of the organism or are determined by some basic maturational process. While the duration or strength of the models may be different, it is believed that the experimentally produced models are developed in the same manner and are governed by the same processes as the naturally developed ones, and therefore, it may be possible through experimental manipulation, to gain some understanding of the infant's cognitive development.

Indeed, one might view the perceptual-cognitive development of the opening years of life as the maturation and alteration of these models, and it is believed that infant attention is in large part influenced by this process. This is not to overlook the importance of stimulus characteristics such as intensity, movement, contour and size which produce what William James (1890) has called "passive immediately sensorial attention." While these stimulus dimensions are important for attentive behavior, it would appear that model acquisition has more important significance for developmental inquiry.

Thus, the theoretical umbrella under which the experiments to be presented were conducted holds that amount of response decrement to a repeated signal is a measure of the speed of model acquisition and is associated with the efficiency of the model building system. The evidence to support this hypothesis consists of two parts. First, organism status variables usually considered to be predictors of efficient perceptual-cognitive capacity are found to be related to response decrement. These include age, state, extent of brain damage, and socioeconomic status. Second, the rate of response decrement to repeated stimulation was directly related to cognitive capacity as measured by tests of IQ and concept formation.

In a recent paper summarizing the work to date, we (Lewis, 1967) were able to show that there are age changes in response decrement

to a repeated stimuli, such that within the first three years older infants show more rapid response decrement than younger ones.

Infants in the first three years of life were presented with a repeated visual signal lasting 30 seconds with a 30-second inter-trial interval. Four trials were presented and both fixation time as well as cardiac deceleration responses were observed.

The data from three experiments indicated that fixation time decreased over trials and that the degree of response decrement was directly related to age, the youngest infants showing the least response decrement. The cardiac response, specifically, the amount of cardiac deceleration--a measure found to be related to attention (Lewis, et al., 1966; Lewis & Spaulding, 1967)--also showed a decrease over trials, the youngest infants again showing the least response decrement. To extend the generality of the results, other visual stimuli (such as different blinking light patterns and a configuration of curved lines) were presented to another sample. The results still indicated an age effect in amount of response decrement.

In a fourth experiment, the number of trials was extended from four to nine and the age effect was again significant. In older infants (1 1/2 - 3 years), attention eventually approached an assymptote at some minimal level suggesting a well-formed model, but younger Ss, even after nine trials, were not able to acquire a satisfactory schema.

In all the experiments, the intertrial interval was 30 seconds which may be too long for a very young infant's memory span. If this is the case, each repeated trial represented a new event for the young infant. Few experiments varying the intertrial interval have been performed using infants as Ss. Saayman, et al. (1964) produced response decrement in 3-month-olds by presenting one long trial of approximately four minutes. One could think of one long trial as having a 0-second intertrial interval length. Bridger (1961), using neonates and various intertrial intervals, could best elicit response decrement to a repeated loud tone when the intertrial interval was less than five seconds. This result is supported by Bartoshuk's (1962) failure to find a difference between intertrial intervals of 60, 30 and 15 seconds. Moreover, the data for adult Ss clearly indicated increased response decrement as a function of shortening the intertrial interval (Geer, 1966). Using 12-week-old subjects, we have varied the intertrial interval, using 0, 5 and 15 seconds. The data indicate that 12-week-old infants tend to habituate if the intertrial interval is short enough; that is, on the order of 0-5 seconds, the intertrial interval that Bridger found to be effective. While there are several alternative explanations for the data, age differences are best explained in terms of differential rates of model acquisition, with younger infants failing to build up models as rapidly as older ones.

Besides important age differences in response decrement, there are significant differences related to birth condition, another organism status variable known to affect cognitive capacity. Specifically, infants in relatively poor condition at birth (as indicated by Apgar scores) showed significantly less response decrement than did Ss whose birth condition was rated as perfect. A similar result was found by Eisenberg, Coursen & Rupp (1966). Further evidence that physical trauma associated with central damage affects response decrement is reviewed by Thompson and Spencer (1966) and shows that animals with experimentally produced brain lesions failed to show response decrement. Psychic trauma can also affect response decrement as is demonstrated in a study by Israel (1966).

Amount of response decrement to visual stimuli in infants was found to be related to patterns of attention in free play. At 13 / months, infants who habituated rapidly to the visual stimulus, lost interest rapidly in individual toys and showed more toy changes than infants who showed little response decrement. Thus, amount of response decrement may be indicative of a more general individual response pattern which extends over various perceptual and cognitive areas.

Finally, both rate of response decrement and frequency of toy change were related to the socioeconomic status of the infant's family. Parents of relatively high socioeconomic level tended to

have infants who showed rapid response decrement and frequent toy change, while low SES parents tended to have infants with little response decrement and few toy changes.

Up to this point in the discussion, the evidence presented indicates that response decrement is associated with those organism status variables usually considered to be predictors of efficient perceptual-cognitive capacity. Thus, older infants should have more capacity than younger ones, infants without brain damage more than damaged ones, etc. However, no evidence of a direct nature has been presented which would demonstrate that infants with greater response decrement to redundant signals perform better on some cognitive tasks than infants who show relatively less response decrement.

Two studies are now reported which show a direct relationship. For 40 infants seen at approximately one year, a full scale Stanford-Binet IQ score at 44 months of age was obtained. A positive and significant correlation between IQ score at 3 1/2 years and rate of response decrement at one year was found (girls, rho = .46; boys, rho = .50, $p<.05$). This indicates that the greater the response decrement at a year, the higher the IQ at 3 1/2 years.

In a second study, 20 Ss were seen at 3 1/2 years and were given a concept formation task as well as a series of redundant visual signals. Comparing the response decrement to a visual signal

with the total number of errors across six different concept tasks reveals a significant correlation (rho = .37, $p<.05$) such that Ss who show greater response decrement show greater concept attainment. Here then is clear evidence for the relation between response decrement and cognitive capacity.

In summary, response decrement to repeated signals was found to be related to a wide variety of organism status parameters: (1) age, (2) lesions, (3) mental disease, (4) birth condition, (5) other measures of satiation, (6) socioeconomic status. Moreover, response decrement was shown to be directly related to (7) measures of cognitive capacity such as IQ in the preschool child and (8) performance on a concept formation task.

The data to date, therefore, suggest that the use of response decrement as a measure of model acquisition, reflecting perceptual-cognitive development, may be a good index on which to judge the effect of maternal behavior on the infant's development.

Method

Subjects

Twenty Ss 12 weeks of age (± four days) were employed in order to test the effect of maternal behavior on the infants' development. Each S was brought to the Institute in the morning by his mother.

Apparatus

Two situations need be described. The first is the controlled naturalistic setting in which maternal and infant behavior was observed and the second is the experimental situation in which response decrement data were obtained.

Controlled Naturalistic Setting

The observation of mother-infant interaction may be carried out either in the home or in the laboratory. Each method has some advantages and limitations. Observations carried out in the home permit both mother and infant to remain in familiar surroundings and carry on in their normal context. However, the "normal" setting will necessarily be different for each mother-infant pair and render any evaluation of individual differences difficult to compare. Not only is the home setting variable, but the activities and demands of other members of the family may actually interfere with the interactions with which the observer is concerned. Finally, the presence of the observer may lead to atypical behavior on the part of the mother or the infant. In one attempt to overcome this problem, Moss (1967) describes techniques for reducing the mother's self-consciousness. In this study, the observer spent several hours in the home on two occasions prior to each 8-hour observation. The mothers were told to pursue their normal routines and it was emphasized that the

infant and not the mother was the subject of observation. Even under these conditions, it cannot be assumed that the presence of another adult had no effect on the mother's behavior. For example, in the Moss study, the correlation between infant irritability and maternal contact was .52 at three weeks of age. Given an irritable and crying baby, the mother is much more likely to hold him in the presence of another adult than when she is alone. In the presence of a relative stranger, this would be even more true. One might expect either a positive or no relationship between infant irritability and maternal contact. That is, if S is extremely irritable, the mother eventually may not respond to it at all. The presence of an observer might make a zero correlation positive and a low positive correlation high. Thus, the presence of an observer known to the mother makes the interpretation of any finding unclear.

Laboratory observations have the distinct advantage of enabling the experimenter to control the environment so that each observation is made under identical conditions and individual differences can be objectively evaluated. The mother and infant can be alone without the interference of other household events or the observer. On the other hand, the laboratory situation is artificial and places both mother and infant in an unfamiliar place which produces anxiety on the mother's part and therefore leads to different levels of interaction.

For our purposes, it was desirable to construct a controlled situation for observation in order to observe individual differences. At the same time, it was necessary to create as natural a setting as possible in order to elicit realistic interaction. A controlled, naturalistic setting was decided upon. This was done in the following way.

One hour prior to testing these infants, the mother and the infant were left alone in a room which was filled with an assortment of furniture, cribs and current popular magazines to read. The mother was informed that the equipment was warming up, given a cup of coffee if she wished, and was left alone. The baby was placed in a reclining infant seat in view of the mother. Finally, the magazines were pointed out and E left the room. These procedures were identical in every case and were designed to produce a controlled naturalistic setting. Two particular manipulations are to be noticed. One, the currency of the magazines (and therefore, their positive valance) was manipulated by changing the magazines regularly. This detail is an example of the attempt at controlled naturalistic observation. The second manipulation had to do with taking the baby from the mother. By doing this, we required each mother to make a discrete and measurable response in order to recover her infant, and, moreover, might have made it easier for the mother not to interact with the

infant if she so desired. In this way, an attempt was made to produce a wider distribution in the mother's response to the infant.

Every 10 seconds, an observer unknown to the mother recorded the occurrence of various behaviors; e.g., whether the mother looked at, smiled, vocalized, held or touched the infant. Also recorded was whether or not the infant's eyes were open or closed, whether he moved, cried or vocalized. Moreover, each time the infant exhibited one of these behaviors, the observer recorded the nature of the maternal response, if any, and its latency. High inter-observer reliability was obtained for these behaviors (rho = .77 to .89).

Experimental Session

At the end of the observation period, the mother was interviewed. The duration of the interview varied depending on the state of the infant--if the infant was sleeping he was not awakened. No infant was tested until he was awake, alert, and not fussy. The experimenter then brought the mother and the infant to the experimental room. The infant was placed in a reclining seat and the mother sat to the rear and side of S. The infant and mother were completely enclosed and except for several small observation windows, were surrounded by a uniform gray area. Immediately in front of S and approximately 18 inches from his head was the matrix panel on which the stimuli were presented. The matrix panel consisted of a plexiglass board

containing six rows of six lights forming a 6 x 6 matrix which could be programmed to present any kind of temporal or spatial pattern. In this experiment, the stimulus was a single blinking light in the center of the panel. Each of the four trials consisted of this light blinking once every other second for 30 seconds. The intertrial interval was 30 seconds.

During the testing session, the infant's attention to the stimulus was coded by two observers as follows. Each time S oriented his head and eyes toward the screen, each observer depressed a key marking the duration of that fixation on an event recorder. The interscorer reliability for total fixation was r = .94. Amount of response decrement was computed by subtracting the amount of time looking on trial 4 from total fixation on trial 1.

Results

The correlations between response decrement and each of the maternal behaviors were computed. Data for one infant who could not be quieted for the matrix episode and two infants who slept for the entire observation period had to be omitted from the analysis. Response decrement was positively correlated with the amount of touching the mother exhibited (rho = .45, $p<.05$), amount of looking (rho = .65, $p<.01$), amount of holding (rho = .38, $p<.08$) and amount smiling (rho = .26) and negatively correlated with the amount of time

the mother was reading (rho = -.38, $p<.08$). These correlations indicate that the more stimulation the mother provided the infant, the greater was the decrement to the repeated signal.

In order to explore the contingency relationship, the frequency of maternal response to each infant behavior was expressed as a percentage score. Thus, the percentage of time each mother responded to an infant behavior, independent of the number of times the behavior was emitted, was obtained. Crying and vocalizing were the only infant behaviors that occurred with sufficient frequency to compute correlations with response decrement. The correlation for percentage of maternal response to vocalization was rho = .53 ($p<.05$) and for response to crying was rho = .44 ($p<.05$). Thus, higher frequencies of maternal response were associated with greater response decrement.

A third approach to the contingency of the response data was to examine the latency of the mother's response to each infant behavior. Since the data were recorded in 10-second intervals, latencies of maternal responses could only be scored as occurring in the same 10-second period as the infant behavior or in a subsequent 10-second period. The maternal response was expressed as percentage of short latency responses independent of the amount of infant behavior. The correlations (rho) with response decrement were .33 for maternal latency to vocalization and .31 for latency to crying. Although

neither of these correlations attains significance, both are in the predicted direction and may be considered suggestive of a relationship between maternal latency of response and response decrement. Infants whose mothers responded more rapidly to their behavior tended to be more efficient in processing repeated signal information. One refinement in data collection which would be essential in further study of this finding would be exact recording of latencies. If one considers the 3-month-old infant's memory span to be approximately five seconds, the present technique does not discriminate between maternal responses within that time period and responses with latencies as long as 10 seconds.

The data consistently indicate that there is a positive correlation between maternal response to infant behavior, such as vocalizing and crying, and the cognitive development of the infant as measured by response decrement. Furthermore, the correlations indicate that the latency of the maternal response and contingency of maternal response (i.e., not whether she stimulated the infant, but whether she stimulated after S's behavior) are important variables in these interactions.

Discussion

Earlier, three theoretical systems were briefly presented to account for the dynamics of mother-infant interaction: (1) amount

and variety of stimulation provided the infant by the mother, (2) reinforcement of behavior of the infant by the mother, and finally, (3) a contingency paradigm involving, not the learning of a particular behavior, but a generalized expectancy. This expectancy or motive was the infant's belief that his behavior could affect the environment.

It is clear that while varied stimulation level is important (Hunt, 1963), the amount of stimulation per se is not a sufficient condition. For example, the infant in an overcrowded slum with many other siblings would be receiving vast amounts of stimulation from a variety of sources. However, one would not view this type of varied stimulation situation as conducive to cognitive development because the stimulation is random in terms of its relationship to the infant. For example, there would be no contingency relationship between stimulation level and the level of alertness of the infant. Indeed, other data from the Fels Infant Study shows a negative correlation between attentiveness and number of siblings.

The reinforcement notion of Gewirtz has more validity in that it argues that the mother's role is that of reinforcer for sets of behavior she wishes to reward or punish. However, this view limits the development of the infant's response repertoire to those behaviors being reinforced. In the case of the present experiment,

it would account for increases in smiling and crying behaviors, but not attentive ones. This position could clearly not account for the development of the vast amount and varied complexity of the infant's response repertoire. If, however, one concludes that the maternal reinforcement not only reinforces a specific response, but helps to create a generalized expectancy within the infant about his effectiveness in obtaining rewards or punishment in the world, the role of maternal reinforcement becomes clearer.

While the following discussion will stress the acquisition of this generalized expectation, it is to be noted that each of the other two aspects of the mother-infant interaction contributes to the development of the infant.

Perhaps the first body of work relating to the generalized expectancy of control of helplessness comes from the psychiatric literature. Adler's (Ansbacher & Ansbacher, 1956) concept of striving for superiority can be viewed as man's struggle to become more effective in controlling his personal world, and R. W. White's notion of competence (1959) are clearly relevant to this discussion. There are, however, more salient data to be found in the literature to suggest that this motive has important developmental consequences.

Provence and Lipton (1965) in their study of institutionalized infants provide information to support this motivational view. The

authors showed that institutionalized infants differed from home-reared infants not in whether they exhibited a skill or when they reached a developmental stage, but whether they utilized the skill. For example, their data indicated that the institutionalized infant stood up in his crib at about the same age as the home-reared infant. That is, the maturational sequence was unfolding at the same rate for each of the groups, but the institutionalized infants showed no desire to practice the skill. It appeared to Provence and Lipton that these infants were not motivated to stand. Thus, it was the motive rather than the skill or structure that differentiated these groups. It was not how much of the skill or structure that was important in differentiating the infants, rather it was the motivation to use the skill. It is suggested that the basic quality of that lack of action was the infant's belief that his behavior could not affect the environment. With such a belief, it was little wonder that they gave up.

Most recently, Maier, Seligman and Solomon (1968), in experimenting with Pavlovian and instrumental conditioning paradigms, have come upon a phenomenon in the failure to learn which they have labeled helplessness. In their experimental paradigm, dogs first experienced unavoidable shock in a Pavlovian conditioning situation where shock was the US. After experiencing this situation, the

animals were placed in an instrumental avoidance situation in which they had to learn to avoid shock by going from one area in a shuttle box to another. Maier, et al. found that after a minimum of unavoidable shock experience, the animals (67 per cent)were unable to learn the instrumental behavior (leaving the area of the box) to avoid or even escape the shock. In searching for a reason for the failure of these animals to learn, the experimenters argue that the most parsimonious explanation involves the notion that the animals acquire expectations about the outcome of their acts. They postulate that in the Pavlovian conditioning situation, where shock is unavoidable, the animal learns that shock or rather the cessation of shock is independent of any response he makes. That is, Maier assumes the animal produces many different behaviors, some of which sometimes accidentally work (the shock goes off) and then do not. Thus, the animal learns not only is no behavior effective (that would be some type of learning), but even more important, it learns that the contingency between his action and outcome is zero. The animal has learned in the Pavlovian conditioning paradigm that no behavior he can produce will consistently affect the shock. He then generalizes this belief to other situations and so he sits in one compartment of the shuttle box and neither escapes nor avoids; that is, he sits there and "takes" the shock. Considering the intensity of shock

used in these experiments, the lack of any attempt to escape or show superstitious behavior is indicative of the animal's helplessness. And the animal's helplessness is a result of his learning through noncontingency training that "nothing I do matters." Note that this phenomenon only occurs when unavoidable shock in a Pavlovian conditioning situation precedes the instrumental conditioning situation. Thus, it is clear that this learned motivational principle of helplessness is extremely important in determining subsequent behavior such as cognitive development or learning.

A third area of research relating to this generalized expectancy has been carried out under the press of Rotter's social learning theory (1954). In Rotter's learning theory, the potential for any behavior to occur under a given situation is a function of the expectation that the given behavior will be effective in securing the available reinforcement, and the value of that reinforcement for the person. The generalized expectancy is that belief, generalized over many situations, that the individual's behavior will or will not be effective in producing the desired reinforcer (for a most recent presentation of his views, see Rotter, 1966). Internal control characterizes individuals who generally believe that their behavior can affect reinforcement--positive or negative--while external control refers to individuals who generally believe their

behavior is not effective in producing reinforcement (Rotter, Seeman & Liverant, 1962). In a recent study (Katkovsky, Crandall & Good, 1967), parental antecedents of internal and external control expectancies were studied. The parental antecedents of general babying, protectiveness, affection and approval are all significantly correlated with the development of the child's belief that he can affect his environment, that he can effect reinforcement by his action.[3] From the observation of the mother-infant interaction, such behaviors as described above are usually associated with close physical contact and responsiveness, both characteristics which should enhance the consistent and short latencies reinforcement contingency characteristics discussed below.

Moreover, the relationship between belief in internal control and perceptual-cognitive and achievement behaviors is well documented. Crandall, Katkovsky and Preston (1962) found that intelligence test scores and reading and arithmetic performance were significantly related to an internal control belief. Recent studies (Cellura, 1963; Chance, 1965; Coleman, et al., 1966) all found significant relationships between school performance and internality. McGhee and Crandall (in press) found perceived control predictive of performance in school as well as achievement test scores, and Crandall (personal communication) recently found a significant relationship

between internality and performancé on the Witkins Embedded Figures Test. Finally, investigations (see Lefcourt, 1966; Rotter, 1966, for two reviews) have demonstrated great individual differences among children and adults in this motive. SES data indicate that, in general, the lower SES groups show less internality than the higher SES groups. That is, lower class children, often Negroes, demonstrate that they lack the belief that their actions can affect their environment (Franklin, 1963; Battle & Rotter, 1963; Lefcourt & Ladwig, 1965; Coleman, et al., 1966). Moreover, that young children rather than older ones also show less internality (Crandall, Katkovsky & Crandall, 1965) suggests that deprived groups, in general, possess less of a belief that they can control their reinforcement.

Studies with children and adults all point to the position that the belief in control or conversely belief in helplessness in affecting one's environment is an important motive in subsequent perceptual-cognitive ability.

A Generalized Expectancy--A Motivational Model

The experimental data as well as the observational information collected by a wide variety of investigators demonstrates that helplessness or control is a learned motive and has important consequences for subsequent perceptual-cognitive development.

The proposed model is a motivational construct developed by the infant through the mother-infant interaction. The construct is a

generalized expectancy that his behavior has consequence in affecting his environment. The learning of this motive is dependent upon consistent reinforcement with short latencies (that is, before the memory trace of the infant's act is gone). An example will serve to illustrate this construct.

The infant experiences some uncomfortable somatic sensation (call it hunger) to which he responds by crying. Assume that the mother, hearing the cry, goes to the infant, picks him up, and feeds him. If her behavior is consistent, it reinforces the event-action relation (namely, discomfort-cry) and develops within the infant a plan or expectation. It is difficult to imagine a perfect relationship where the mother always knows what to do and can always do it. Thus, the degree of her consistency will be an important variable with greater consistency resulting in a stronger motive. The plan or expectation built by the infant is produced in this manner: uncomfortable sensation ↠ action ↠ cessation of sensation. In other words, his cry or behavior was effective in relieving his pain. How much different is this from the experience of the infant who cries under the press of an uncomfortable somatic sensation and is not picked up and fed consistently or who cries and is not attended to because his mother, busy with other children, cannot reach him until several minutes after the onset of crying when he can no longer

remember the event-action relationship.[4] Or the institutionalized infant who, because of the institution's schedule cannot be held when he wants to be and is held when he does not want to be. In other words, although he may receive equal amounts of stimulation, these are noncontingent on his action and thus, the principle of affecting his environment by his action is not learned well or is delayed. It is clear that all infants receive some degree of contingency experience. What is being discussed is the belief that the quantity of contingency experience is instrumental in developing the strength of this motive.

Moss (1967) suggests that in the early weeks of life, maternal behavior is controlled by the S-R conditions provided by the infant. As he gets older, "The mother, if she behaved contingently toward his signals, gradually acquires reinforcement value" (emphasis added). Moss views this point (where the infant's control of the mother declines and the mother's reinforcement value emerges) as the initial condition for social learning. We would extend this notion to say that the mother's acquisition of reinforcement value is only one indication that the infant has learned to expect environmental pay-off and this is the basis for future learning. When the infant has acquired this expectation, he is potentially capable of instrumental behaviors other than those already reinforced. The behavior

of the infant is increasingly intentional and motivated by the expectation of producing a desired result. Thus, the belief in control which emerges as a consequence of early contingency experience mediates subsequent S-R experiences. What is being suggested is that not only are S-R bonds being made for specific response patterns but that a motive (some type of cognitive process) mediating the production of subsequent responses is being developed. This motive "to behave" (which can include specific responses and/or general processes like exploration and attention) while dependent originally on reinforcement of specific behaviors, eventually becomes independent of these external reinforcements.

Finally, the operant conditioning approach which assumes that the initial behavior is emitted accidentally or at random does not adequately account for the rapidity with which new behaviors occur or the extent and complexity of the infant's behavioral repertoire. It is necessary to assume some internal state which motivates production of new behaviors. While this internal state is certainly in the service of a maturational sequence, it is suggested that it is also in the service of the motive to control based on the infant's expectation that he can effect change.

Initially, the mother serves as the major source of reinforcement of the S-R bonds and therefore, the source of this generalized

expectancy. Given the basic development of this motive, the infant soon learns that he can obtain payoffs from the environment other than the mother. The generalized expectancy can then be facilitated by the environment as well as the mother. However, in the earliest months, it is primarily the mother who serves as the reinforcer. The mother, therefore, would appear to have two functions: one, initially to serve as the contingency producer (and creator of the expectancy) and two, to provide an environment which facilitates the infant's self-reinforcement, e.g., toys which can be reached for and touched, etc.

Several important dimensions of this motivational construct are the speed with which it can be formed and the duration and strength of the expectation. The Maier, et al. data with animals and Provence and Lipton's data with institutionalized infants argue for the belief that the acquisition of the motive can occur within a relatively short time; in the Maier, et al. experiments, it occurred within a relatively few trials. Both of these studies dealt with the acquisition of helplessness and whether the same speed is involved in the acquisition of control is not yet known. If the acquisition of the expectancy of control is acquired as quickly as helplessness, the motive could easily be acquired in the opening months of life.

The duration and strength of this motive is a more complex issue. Again, referring to the Maier, et al. data, the results

indicated that not only is the motive learned in a few trials, but experiencing the unavoidable shock condition an additional time after the instrumental conditioning procedure renders the motive inextinguishable. The data indicate, therefore, that once well learned, the motive is not reversible. Whether this is true for infant and human development is not clear. It does seem possible, however, that the motive results in differential behavior patterns whose consequences would tend to reinforce the motive. Thus, whether the motive remains irreversible or whether the behaviors, as a consequence of the motive sustain the expectation, is not clear. There is some indication in the deprivation studies that the process is irreversible. However, whether this refers to the motive or the sets of behavior learned or not learned as a consequence of the motive is not clear.

The contingency relationship has been argued to be effective in producing a generalized expectancy of control or helplessness. Yet to be answered is how this learned expectation can affect perceptual-cognitive development and specifically, response decrement to a redundant signal. The answer seems to be multiple. First, the lack of this expectation should reduce the infant's exploration of his environment; that is, if he cannot affect change or outcome, why pay attention to it? This lack of interest should prevent the infant

from exploring his environment and enriching his set of experiences, expectations and schemata. Further, it is suggested that sensory processing not only involves orientation toward stimulation or exploring the environment, but a desire (an active process) to assimilate the information. In a visual exploration, this might be seen as the difference between an empty stare versus a taking in and processing--accompanied by cardiac deceleration. In both cases, the infant orients, but only in the latter is the information absorbed. There is evidence available, other than that presented above, that the mother-infant interaction can affect the desire for novelty and familiarity (Rubenstein, 1967). Moreover, Watson's (1966) observation that contingency training increased attentive behavior and responses other than those reinforced is particularly relevant. Finally, without this expectancy, the infant is unlikely to rehearse developing skills and structures as they unfold in their developmental sequences. Thus, new skills are lost and additive functions do not occur. While the exact nature of the effect of this generalized expectancy on response decrement is yet unclear, it is thought that infants with a relatively weaker expectancy should have less motive to process the signal and therefore take longer to build a model.

In conclusion then, what has been proposed is that the reinforcement of specific S-R bonds by the mother is effective in

increasing the occurrence of that particular reinforced behavior; but more important, it develops within the infant the expectancy that his behavior can affect his environment. Given this expectancy, the infant is motivated to produce and utilize behaviors and skills not reinforced in his past experience. Thus, this motive can be thought to mediate the occurrence of new behavioral responses.

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Footnotes

1. This research was supported in part by Grants # HD-00868, FR-00222 and FR-05537 from The National Institute of Mental Health, United States Public Health Service.

2. Watson (1966) does suggest that the operant conditioning paradigm does have facilitating consequences on behaviors that were not specifically reinforced. The explanation of this phenomena rests on White's (1959) notion of competence.

3. Without limits or over long periods of time such maternal behaviors as babying, protectiveness, approval, etc. may result in Ss developing an expectation that others will reinforce him; i.e., what may be facilitating maternal behavior in infancy may be debilitating at a later time. Moreover, it appears that there are personality factors beside those of cognition which need to be dealt with.

4. The case of the infant crying because he was hungry may represent a more interesting example than initially imagined. Because his crying and hunger probably remained paired over a relatively long period of time, it might be possible that when the mother finally responded, she might still be able to help development of the infant's contingency awareness. That is, as long as the original source of the cry and the cry itself remain present, it might be possible to link event and action. This is a particularly important point, for unless this were possible, most event-action pairings would not take place because of the long latencies usually found in the infant's natural environment.